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FAILURE RATE OF LONGWALL SYSTEM MACHINES BY THE TYPE OF FAILURE – CASE STUDY

Deposits in the form of seams are most often exploited by means of mechanised longwall systems. Hard coal seams of various thicknesses are mined by plowing and shearer complexes. Both solutions are commonly used in Polish and global mining. Mechanised longwall systems consist of many machines, the most important of which are the mining machine, powered support, armoured face conveyor and beam stage loader. The article is concerned with the failure frequency of longwalls equipped with plow and shearer longwall systems in one of the Polish hard coal mines. The analysis covers a period of 13 months of the mine's operation, during which 2,589 failures were recorded. It was carried out for all longwalls exploited in that period, i.e. five plow and five shearer ones, operating in six different sections. In the analysed period, these longwalls worked for an average of 150 days, and a total of 1,484 days. The analysis takes into account the basic division of failures used in the mining branch, i.e. mining, electrical and mechanical failures. The plow and shearer complexes were analysed separately, taking into account the failure category for all devices. A comprehensive analysis of the failure rates has revealed that the failure rate of longwalls equipped with plow complexes is noticeably higher than that of shearer ones. Moreover, it has been demonstrated that mining failures are prevalent in the analysis of both the number of failures and the average duration of failures.

Keywords: Machine failure rate; plow complexes; shearer complexes; effective working time

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1. Introduction

Hard coal extraction can be carried out with the use of various mining systems. Hard coal in the form of seams is mainly mined with longwall systems. The main advantages of longwall systems include a small amount of preparatory work, low operating losses, high concentration of extraction, easy roof control, the possibility of full mechanisation of works and easy supervision of movement in the longwall. A longwall of a specific length, panel length and height is extracted by means of a mechanised longwall complex equipped with a cutting and loading machine in the form of a longwall shearer or a static coal plow. Both the plow and shearer complexes are very well-known and have been extensively discussed in many articles [1-16].

The best possible use of a fleet of machines results in high operating efficiency. In practice, efficiency is defined by various indicators, which take into account several factors, especially failures. Apart from breakdowns, however, it is worth paying attention to downtime, disassembly of machines in the longwall and factors independent of the analysed set of machines. There are various measures for assessing machinery supervision, including OEE, MTBF, MTTR, and MTTF [17]. The most popular indicator is OEE – Overall Equipment Effectiveness. The MTTR indicator – Mean Time To Repair, determines the average time needed for a repair when a failure occurs.

The MTBF indicator – The Mean Time Between Failure refers to the statistical measure of how often a particular machine or group of machines experiences breakdowns. In enterprises, it is used to establish the schedule of preventive inspections. The indicator is understood as the average working time between failures in a specified time. The MTBF indicator is the sum of MTTR and MTTF.

The failure rate of machines and devices, depending on the reporting method and available data, can be described by many numerical indicators. In this case, the most appropriate indicator to study is the average failure duration, based on the available data regarding the recorded failures. Duration of failure per one day of system operation and duration of failure expressed as the result obtained in the form of the amount of excavated material, taking into account the share of gangue, will allow comparing the shearer and plow techniques. Currently, the subject literature does not provide any comparisons of the plow and shearer techniques illustrated by an example of data from plants with the same working conditions. Only single studies regarding the failure rate of various mining machines can be found [18-26]. In one of the articles, measures that can be used to describe the failure frequency of longwall system machines have been discussed, and selected data has been presented [27].

2. Object of analysis: shearer and plow longwall failure rate

In the analysed period, the longwall systems worked for 694 days, during which 7,247,000 Mg of excavated material was obtained, whereas the plow systems worked for 790 days, yielding 6,523,000 Mg of excavated material. On average, the shearer complexes obtained 10,400 Mg/d, and the plow ones – 8,300 Mg/d. Due to the different working times of the longwalls and the different amounts of excavated material, the analysis was made more specific, and the indicators based on one day and one thousand Mg of excavated material were applied.

The conducted analysis was based on reports prepared by mine employees. The data consisting of all key information is collected and inputted into an Excel spreadsheet.

TABLE 1

Summary of the analysed longwalls' parameters

Item	Section	Longwall	Technique	Mining machine	Deposit thickness [m]	Longwall length [m]	Panel length [m]
1	G-1	3/II/385	plow	GH1600 CAT4	1.20-1.70	314	1640
2	G-4	3/VIII/385	plow	GH1600 CAT2	1.40-2.00	305	3395
3	G-4	4/VII/385	plow	GHH1600 CAT3	1.35-1.95	305	4634
4	G-6	5/VI/385	plow	GH1600 CAT3+2	1.10-1.80	304	1820
5	G-6	6/VI/385	plow	GH1600 CAT3+2	1.40-2.00	305	1600
6	G-5	2/I/385	shearer	JOY 4LS3	1.40-1.90	318	1600
7	G-5	3/I/385	shearer	JOY 4LS3	1.40-2.10	318	1640
8	G-3	3/IV/389	shearer	JOY 4LS22	1.40-2.70	296	2410
9	G-2	3/V/391	shearer	JOY 4LS22	1.90-2.70	310	2450
10	G-2	4/V/391	Shearer	JOY 4LS22	1.90-2.70	311	1810

Fig. 1. GH 1600 CAT mechanised plow system (www.cat.com)

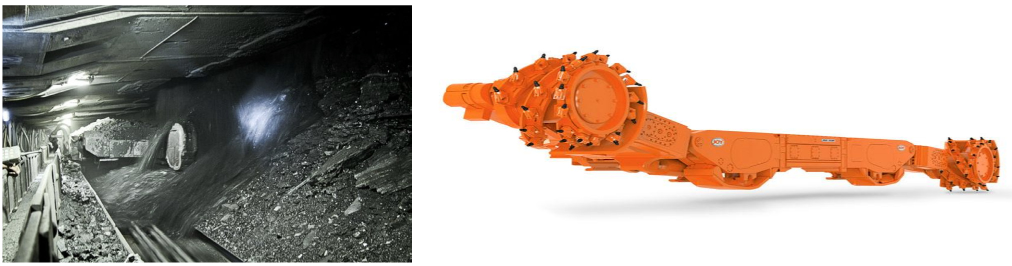

Fig. 2. Mechanised shearer complex (www.lw.com.pl), JOY 7LS0 mechanised longwall shearer (https://mining.komatsu/)

In the analysed period, mining failures accounted for nearly 73% of all failures, while electrical ones – 15%, and mechanical – 12%. Mining failures were also prevalent in terms of numbers, accounting for 64% of all failures, as opposed to electrical failures – 24% and mechanical failures

– 12%. However, it is worth noting that the average failure duration indicates the highest time consumption of mining failures. Mining failures last 10% longer than the average for all failures. Mechanical failures are also characterised by a long repair time, which is comparable to the average value for all failures. In contrast, electrical failures last about 60% of the average time.

The analysis of failures of individual machines and devices was based on the division into types of failures and specific objects. First, it was conducted for the shearer complexes and, next, for the plow systems. The failures were classified into three categories: mining, electrical, or mechanical, in both instances.

To illustrate the proportion of the number and time of particular failures, the total values, as well as the working time and output obtained (per one day, per one thousand Mg), were taken into account in the conducted analysis.

3. Failure rate of shearer longwalls

First, an analysis of the failure rate of 5 shearer longwalls was carried out. Mining, electrical and mechanical failures were analysed subsequently.

The number and duration of mining failures in shearer longwalls are given in TABLE 2. The table also shows the average failure duration for individual objects as well as the percentage duration and number of failures in relation to the total values for mining failures. To obtain comparative failure rates, the number of failures and the duration of failures per one day of the

TABLE 2

Summary of information on the time and number of mining failures in shearer longwalls

	Longwall	Support	AFC	Longwall shearer	BSL	Roadheader	Crusher	Mobile tail piece	Haulage	Shaft	Full retention bunkers
number of failures [-]	119	4	98	29	32	0	2	3	141	1	122
failure time [min]	20545	225	12640	2250	1996	0	35	175	10642	85	18363
average failure time [min]	173	56	129	78	62	0	18	58	75	85	151
number of failures [%]	21.6%	0.7%	17.8%	5.3%	5.8%	0,0%	0.4%	0.5%	25.6%	0.2%	22.1%
failure time [%]	30.7%	0.3%	18.9%	3.4%	3.0%	0,0%	0.1%	0.3%	15.9%	0.1%	27.4%
number of failures [1/d]	0.17	0.01	0.14	0.04	0.05	0,00	0.00	0.00	0.20	0.00	0.18
failure time [min/d]	29.6	0.3	18.2	3.2	2.9	0,0	0.1	0.3	15.3	0.1	26.5
number of failures [1/thous. Mg]	0.016	0.001	0.014	0.004	0.004	0,000	0.000	0.000	0.019	0.000	0.017
failure time [min/thous. Mg]	2.8	0.0	1.7	0.3	0.3	0.0	0.0	0.0	1.5	0.0	2.5

system operation and per one thousand Mg of the obtained output have also been calculated. The number, duration and average duration have been presented in the diagram in Fig. 3. Information on the significance of failures for a given object has been presented by means of Pareto charts for both the number of failures and the failure time in Fig. 4 and Fig. 5, respectively.

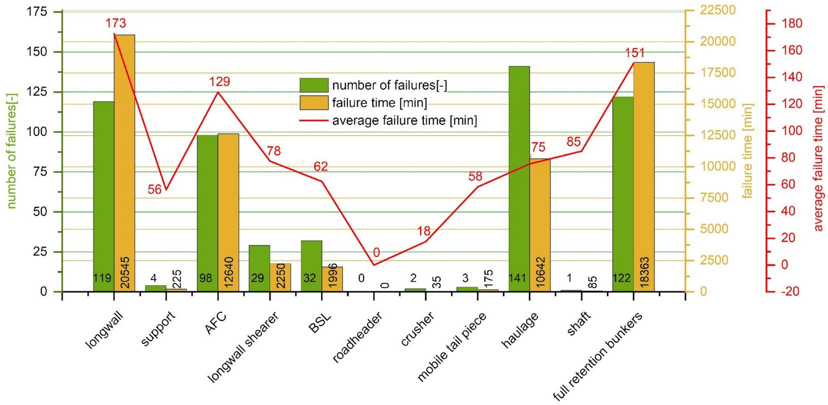

Fig. 3. Number, duration and average duration of mining failures in shearer longwalls

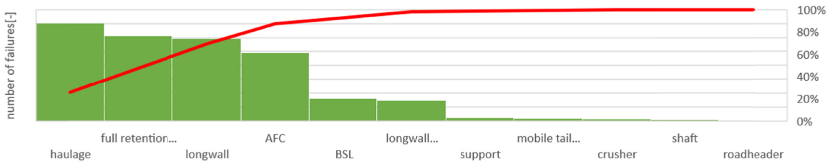

Fig. 4. Pareto chart for the total number of mining failures in shearer longwalls

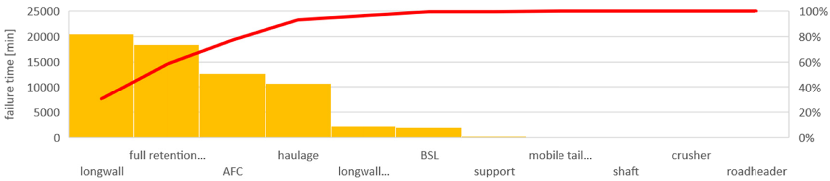

Fig. 5. Pareto chart for the total duration of mining failures in shearer longwalls

The number and duration of electrical failures in shearer longwalls are given in TABLE 3. The table also shows the average failure duration for individual objects as well as the percentage duration and number of failures in relation to the total values for electrical failures. To obtain comparative failure rates, the number of failures and the duration of failures per one day of the system operation and per one thousand Mg of the obtained output have also been calculated. The number, duration and average duration of failures have been presented in Fig. 6. Information on the significance of failures for a given object has been presented by means of Pareto charts for both the number of failures and the failure time in Fig. 7 and Fig. 8, respectively.

TABLE 3

Summary of information on the time and number of electrical failures in shearer longwalls

	AFC	BSL	Support	Longwall shearer	Roadheader	Haulage	Crusher	Longwall	Air-conditioning.	Shaft
number of failures [-]	61	32	2	64	2	77	1	24	3	1
failure duration [min]	3507	2724	145	6233	90	3625	20	1502	70	20
average failure time [min]	57	85	73	97	45	47	20	63	23	20
number of failures [%]	22.8%	12.0%	0.7%	24.0%	0.7%	28.8%	0.4%	9.0%	1.1%	0.4%
failure time [%]	19.6%	15.2%	0.8%	34.8%	0.5%	20.2%	0.1%	8.4%	0.4%	0.1%
number of failures [1/d]	0.09	0.05	0.00	0.09	0.00	0.11	0.00	0.03	0.00	0.00
failure time [min/d]	5.1	3.9	0.2	9.0	0.1	5.2	0.0	2.2	0.1	0.0
number of failures [1/thous.Mg]	0.008	0.004	0.000	0.009	0.000	0.011	0.000	0.003	0.000	0.000
failure time [min/thous. Mg]	0.5	0.4	0.0	0.9	0.0	0.5	0.0	0.2	0.0	0.0

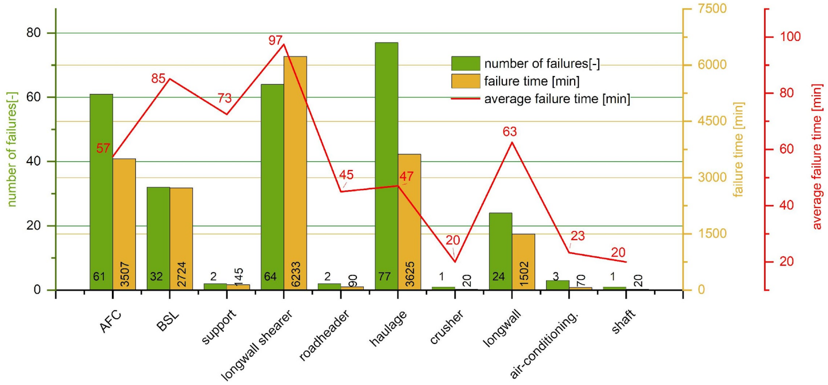

Fig. 6. Number, duration and average duration of electrical failures in shearer longwalls

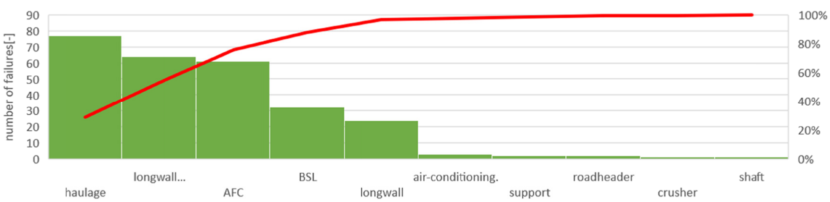

Fig. 7. Pareto chart for the number of electrical failures in shearer longwalls

The number and duration of mechanical failures in shearer longwalls are given in TABLE 4. The table also shows the average failure duration for individual objects as well as the percentage

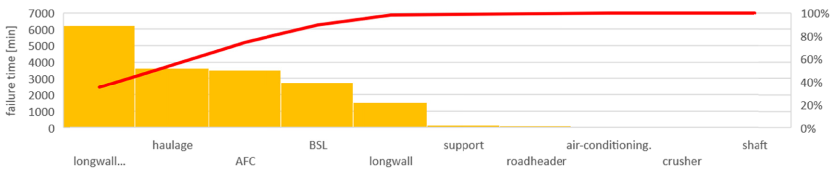

Fig. 8. Pareto chart for the duration of electrical failures in shearer longwalls

duration and number of failures in relation to the total values for mechanical failures. To obtain comparative failure rates, the number of failures and the duration of failures per one day of the system operation and per one thousand Mg of the obtained output have also been calculated. The number, duration and average duration of failures have been presented in the diagram in Fig. 9.

TABLE 4

Summary of information on the time and number of mechanical failures in shearer longwalls

	AFC	**Support**	**Longwall shearer**	**BSL**	**Roadheader**	**Haulage**	**Crusher**	**Mobile tail piece**	**Air-conditioning**	**Shaft**
number of failures [-]	34	20	68	12	2	30	1	1	0	1
failure time [min]	3865	595	6560	1320	140	2530	90	35	0	25
average failure time [min]	114	30	96	110	70	84	90	35	0	25
number of failures [%]	20.1%	11.8%	40.2%	7.1%	1.2%	17.8%	0.6%	0.6%	0.0%	0.6%
failure time [%]	25.5%	3.9%	43.3%	8.7%	0.9%	16.7%	0.6%	0.2%	0.0%	0.2%
number of failures [1/d]	0.05	0.03	0.10	0.02	0.00	0.04	0.00	0.00	0.00	0.00
failure time [min/d]	5.6	0.9	9.5	1.9	0.2	3.6	0.1	0.1	0.0	0.0
number of failures [1/thous. Mg]	0.005	0.003	0.009	0.002	0.000	0.004	0.000	0.000	0.000	0.000
failure time [min/thous. Mg]	0.5	0.1	0.9	0.2	0.0	0.3	0.0	0.0	0.0	0.0

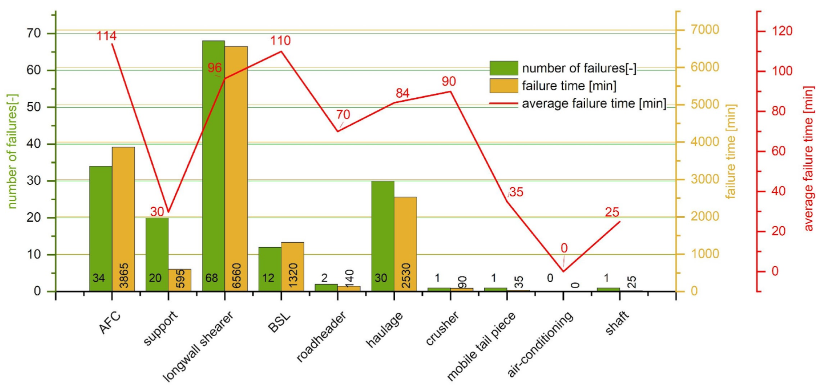

Fig. 9. Number, duration and average duration of mechanical failures in shearer longwalls

Information on the significance of failures for a given object has been presented by means of Pareto charts for both the number of failures and the failure time in Fig. 10 and Fig. 11, respectively.

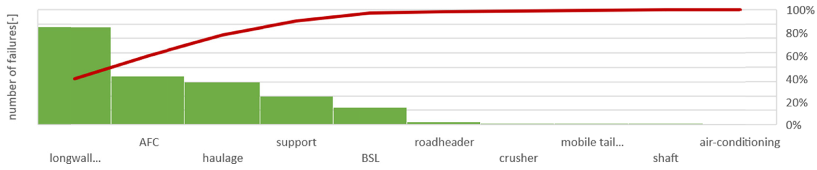

Fig. 10. Pareto chart for the number of mechanical failures in shearer longwalls

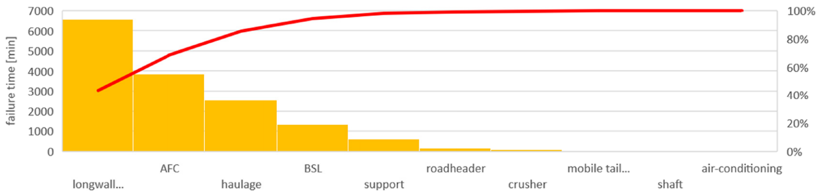

Fig. 11. Pareto chart for the duration of mechanical failures in shearer longwalls

The conducted failure rate analysis for shearer longwalls, with a division into categories by the type of failure and by objects allowed formulating a number of conclusions.

In the case of mining failures:

- The failures were most frequently related to haulage, full retention bunkers, longwall downtime and face conveyor, accounting for more than 85% of the total number of failures.
- The longest lasting failures were those related to longwall downtime, full retention bunkers, face conveyor and haulage, successively accounting for more than 90% of all failures duration.
- Among the major failures, on average, the longest lasting were those related to longwall downtime (173 min), full retention bunkers (151 min), face conveyor (129 min) and haulage (75 min).
- Failures related to longwall shearer accounted for 5% of the number of failures and 3% of failure time.

In the case of electrical failures:

- The failures were most frequently related to haulage, longwall shearer and face conveyor, accounting for more than 75% of the total number of failures.
- The longest lasting failures were those related to longwall shearer, haulage and beam stage loader, successively, accounting for approx. 75% of all failures duration.
- Among the major failures, on average, the longest lasting were those related to longwall shearer (97 min), face conveyor (57 min) and haulage (47 min).
- Failures related to longwall shearer accounted for 24% of the number of failures and 35% of failure time.

In the case of mechanical failures:

- The failures are most frequently related to longwall shearer, face conveyor and haulage, accounting for nearly 80% of the total number of failures.
- The longest lasting failures were those related to longwall shearer, face conveyor and haulage, accounting for more than 85% of all failures duration.
- Among the major failures, on average, the longest lasting were those related to longwall shearer (96 min), haulage (84 min) and face conveyor (114 min).
- Failures related to longwall shearer accounted for 40% of the number of failures and 43% of failure time.

4. Failure rate of plow longwalls

Next, an analysis of the failure rate of 5 plow longwalls was carried out. As before, mining, electrical and mechanical failures were analysed subsequently.

The number and duration of mining failures in plow longwalls are given in TABLE 5. The table also shows the average failure duration for individual objects as well as the percentage duration and number of failures in relation to the total values for mechanical failures. To obtain comparative failure rates, the number of failures and the duration of failures per one day of the system operation and per one thousand Mg of the obtained output have also been calculated. The number, duration and average duration of failures have been presented in the diagram in Fig. 12. Information on the significance of failures for a given object has been presented by means of Pareto charts for both the number of failures and the failure time in Fig. 13 and Fig. 14, respectively.

TABLE 5

Summary of information on the time and number of mining failures in plow longwalls

	Longwall	**Support**	**AFC**	**Plow**	**BSL**	**Roadheader**	**Crusher**	**Mobile tail piece**	**Haulage**	**Shaft**	**Full retention bunkers**
number of failures [-]	406	3	112	161	20	0	2	0	218	0	185
failure time [min]	34213	105	14887	23184	1705	0	65	0	11755	0	36770
average failure time [min]	84	35	133	144	85	0	33	0	54	0	199
number of failures [%]	36.7%	0.3%	10.1%	14.5%	1.8%	0.0%	0,2%	0.0%	19.7%	0.0%	16.7%
failure time [%]	27.9%	0.1%	12.1%	18.9%	1.4%	0.0%	0,1%	0.0%	9.6%	0.0%	30.0%
number of failures [1/d]	0.51	0.00	0.14	0.20	0.03	0.00	0,00	0.00	0.28	0.00	0.23
failure time [min/d]	43.3	0.1	18.8	29.3	2.2	0.0	0,1	0.0	14.9	0.0	46.5
number of failures [1/thous. Mg]	0.062	0.000	0.017	0.025	0.003	0.000	0,000	0.000	0.033	0.000	0.028
failure time [min/thous. Mg]	5.2	0.0	2.3	3.6	0.3	0.0	0,0	0.0	1.8	0.0	5.6

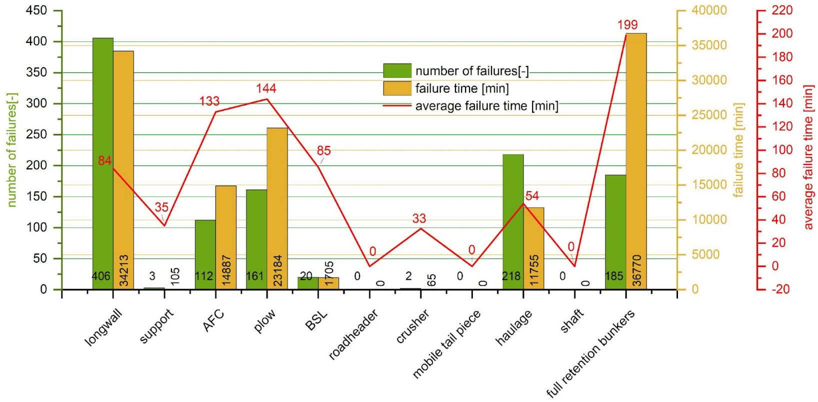

Fig. 12. Number, duration and average duration of mining failures in plow longwalls

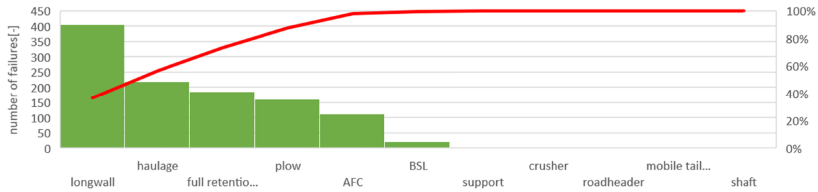

Fig. 13. Pareto chart for the number of mining failures in plow longwalls

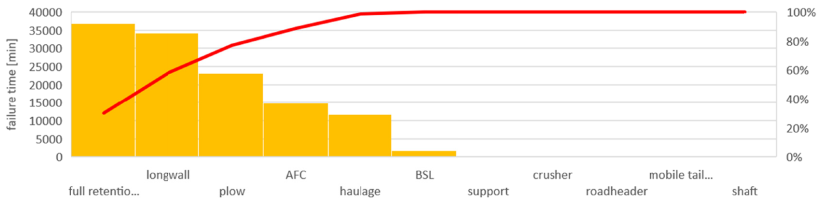

Fig. 14. Pareto chart for the duration of mining failures in plow longwalls

The number and duration of electrical failures in plow longwalls are given in TABLE 6. The table also shows the average failure duration for individual objects as well as the percentage duration and number of failures in relation to the total values for electrical failures. To obtain comparative failure rates, the number of failures and the duration of failures per one day of the system operation and per one thousand Mg of the obtained output have also been calculated. The number, duration and average duration of failures have been presented in the diagram in Fig. 15. Information on the significance of failures for a given object has been presented by means of Pareto charts for both the number of failures and the failure time in Fig. 16 and Fig. 17, respectively.

The number and duration of mechanical failures in plow longwalls are given in TABLE 7. The table also shows the average failure duration for individual objects as well as the percentage

TABLE 6

Summary of information on the duration and number of electrical failures in plow longwalls

	Plow	AFC	BSL	Support	Roadheader	Haulage	Crusher	Longwall	Air-conditioning	Shaft
number of failures [-]	63	69	44	20	4	87	10	56	1	0
failure time [min]	4510	4045	1885	1035	545	3744	600	5755	100	0
average failure time [min]	72	59	43	52	136	43	60	103	100	0
number of failures [%]	17.8%	19.5%	12.4%	5.6%	1.1%	24.6%	2.8%	15.8%	0.3%	0.0%
failure time [%]	20.3%	18.2%	8.5%	4.7%	2.5%	16.9%	2.7%	25.9%	0.5%	0.0%
number of failures [1/d]	0.08	0.09	0.06	0.03	0.01	0.11	0.01	0.07	0.00	0.00
failure time [min/d]	5.7	5.1	2.4	1.3	0.7	4.7	0.8	7.3	0.1	0.0
number of failures [1/thous. Mg]	0.010	0.011	0.007	0.003	0.001	0.013	0.002	0.009	0.000	0.000
failure time [min/thous. Mg]	0.7	0.6	0.3	0.2	0.1	0.6	0.1	0.9	0.0	0.0

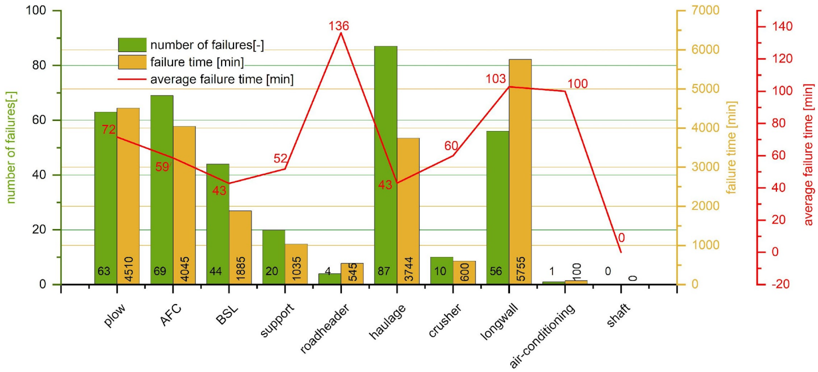

Fig. 15. Number and average duration of electrical failures in plow longwalls

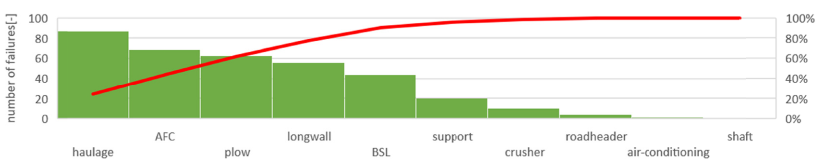

Fig. 16. Pareto chart for the number of electrical failures in plow longwalls

duration and number of failures in relation to the total values for mechanical failures. To obtain comparative failure rates, the number of failures and the duration of failures per one day of the system operation and per one thousand Mg of the obtained output have also been calculated. The number of failures, duration and average duration of failures have been presented in the

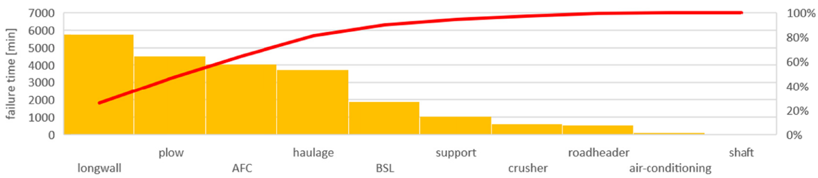

Fig. 17. Pareto chart for the duration of electrical failures in plow longwalls

diagram in Fig. 18. Information on the significance of failures for a given object has been presented by means of Pareto charts for both the number of failures and the failure time in Fig. 19 and Fig. 20, respectively.

TABLE 7

Summary of information on the duration and number of mechanical failures in plow longwalls

	Plow	AFC	Support	BSL	Roadheader.	Haulage	Crusher	Mobile tail piece	Air-conditioning	Shaft
number of failures [-]	51	22	28	6	0	19	1	3	0	2
failure time [min]	7420	3828	1249	570	0	1595	20	135	0	610
average failure time [min]	145	174	45	95	0	84	20	45	0	305
number of failures [%]	38.6%	16.7%	21.2%	4.5%	0.0%	14.4%	0.8%	2.3%	0.0%	1.5%
failure time [%]	48.1%	24.8%	8.1%	3.7%	0.0%	10.3%	0.1%	0.9%	0.0%	4.0%
number of failures [1/d]	0.06	0.03	0.04	0.01	0.00	0.02	0.00	0.00	0.00	0.00
failure time [min/d]	9.4	4.8	1.6	0.7	0.0	2.0	0.0	0.2	0.0	0.8
number of failures [1/thous. Mg]	0.008	0.003	0.004	0.001	0.000	0.003	0.000	0.000	0.000	0.000
failure time [min/thous. Mg]	1.1	0.6	0.2	0.1	0.0	0.2	0.0	0.0	0.0	0.1

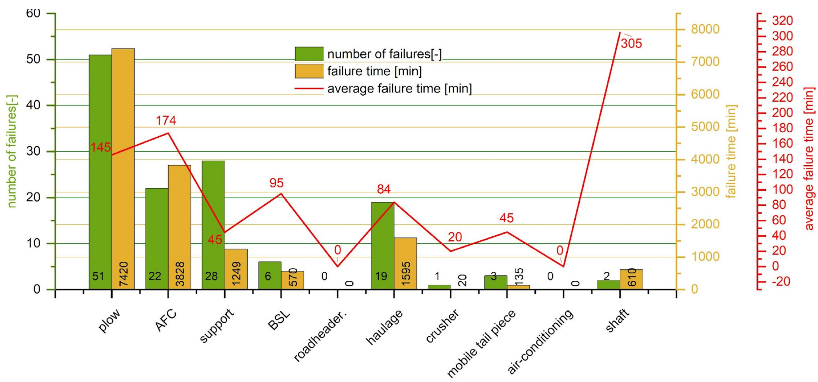

Fig. 18. Number and average duration of mechanical failures in plow longwalls

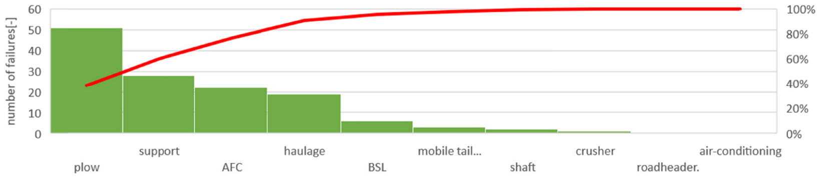

Fig. 19. Pareto chart for the number of mechanical failures in plow longwalls

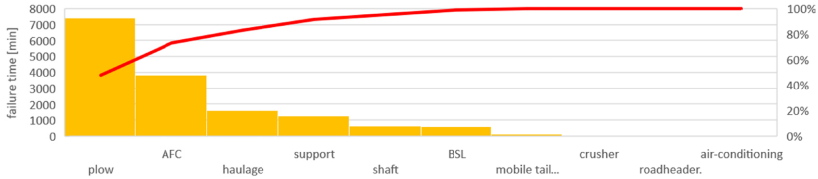

Fig. 20. Pareto chart for the duration of mechanical failures in plow longwalls

After analysing the failure rates of all plow longwalls and categorising them by the type of failure and object, several conclusions were formulated.

In the case of mining failures:

- The failures are most frequently related to longwall downtime, full retention bunkers, plow and face conveyor, accounting for nearly 98% of the total number of failures.
- The longest lasting failures were those related to full retention bunkers, longwall downtime, plow, face conveyor and haulage, successively accounting for more than 98% of all failures duration.
- Among the major mining failures, on average, the longest lasting were those related to full retention bunkers (199 min), plow (144 min.), face conveyor (133 min), longwall downtime (84 min.) and haulage (54 min).
- Failures related to plow account for 15% of the number of failures and 19% of failure time.

In the case of electrical failures:

- The failures are most frequently related to haulage, face conveyor, plow, longwall downtime and beam stage loader, accounting for approximately 90% of the total number of failures.
- The longest lasting failures were those related to longwall downtime, plow, face conveyor, haulage and beam stage loader, successively accounting for nearly 90% of all failures duration.
- Among the major electrical failures, on average, the longest lasting were those related to longwall downtime (103 min), plow (72 min.), face conveyor (59 min.), haulage (43 min.) and beam stage loader (43 min.).
- Failures related to plow account for 18% of the number of failures and 20% of failure time.

In the case of mechanical failures:

- The failures are most frequently related to plow, support, face conveyor and haulage, accounting for more than 90% of the total number of failures.

- The longest lasting failures were those related to plow, face conveyor, haulage and support, accounting for more than 90% of all failures duration.
- Among the major mechanical failures, on average, the longest lasting were those related to plow (145 min.), face conveyor (174 min.), haulage (84 min.) and support (45 min.).
- Failures related to plow account for 39% of the number of failures and 48% of failure time.

5. Conclusions and summary

The detailed analysis of failure rates in objects characterised by the highest number of failures allowed the formulation of many valuable conclusions. The analysis included the objects the failure rate of which might depend on the type of technique used. It was assumed that such an analysis would determine whether the technique used (shearer or plow) had an impact on the number and time of failures related not only to the mining machine itself but also to the face conveyor and beam stage loader, support, longwall downtime and haulage. It should be noted that all of the 10 analysed systems worked in one mine in the same or similar period.

To compare the shearer and plow techniques having regard to equipment subject to failure, a comparative analysis was carried out for mining, electrical and mechanical failures.

Conclusions from the analysis of mining failures:

- The failure rate of the plow system is 400% to 100% higher than that of the shearer system,
- The face conveyor is characterised by a comparable failure rate for both techniques, with an advantage of the shearer technique,
- The beam stage loader is characterised by a 50% lower failure rate for the plow technique,
- The longwall support is characterised by up to 50% lower failure rate in the case of the plow technique,
- The longwall downtimes are characterised by a 50%-280% higher failure rate if the plow system is used,
- The haulage has a failure rate comparable to or higher by up to 70% in the case of the plow technique,
- The full retention bunkers are characterised by a 30%-120% higher failure rate for the plow technique.

Conclusions from the analysis of electrical failures:

- The failure rate of the plow system is comparable to or up to 40% lower than that of the shearer system,
- The face conveyor is characterised by a comparable failure rate for both techniques, with an advantage of the shearer technique by up to nearly 30%,
- The beam stage loader is characterised by a comparable failure rate,
- The longwall support is characterised by a noticeably higher – reaching up to 1000% failure rate in the case of the plow technique,
- Longwall downtimes are characterised by a 100%-330% higher failure rate if the plow system is used,
- The haulage has a failure rate comparable to or higher by up to 30% in the case of the plow technique.

Conclusions from the analysis of mechanical failures:

- The failure rate of the plow system is comparable to or up to 30% lower than that of the shearer system,
- The face conveyor is characterised by a comparable or lower by up to 40% failure rate for the plow technique,
- The failure rate of the beam stage loader is higher by more than 60% in the case of the shearer technique,
- The failure rate of the longwall support is more than 130% higher in the case of the shearer technique,
- The haulage has a failure rate higher by more than 40% in the case of the shearer technique,

Additionally, a comparative analysis of the failures of the plow and shearer complexes was performed without any breakdown by the type of failure.

The conclusions from the summary analysis of failures revealed that:

- Longwall downtimes are characterised by a nearly 260% higher failure rate for the plow technique.
- The failure rate of the plow system is up to 160% higher than that of the shearer system,
- The face conveyor is characterised by a comparable failure rate for both techniques, with an advantage of the shearer technique,
- The beam stage loader is characterised by a comparable failure rate for both techniques, with the advantage of the plow system,
- The longwall support is characterised by a more than 260% higher failure rate in the case of the plow technique,
- The failure rate of longwall downtimes is comparable or higher by nearly 50% if the plow system is used,
- The haulage has a failure rate comparable to or higher by nearly 50% in the case of the plow technique,
- Full retention bunkers concern only mining accidents, hence the conclusions are identical.

The article is devoted to a comprehensive analysis of the failure rate of the shearer and plow longwalls at LW Bogdanka. The analysis concerned 10 longwalls exploited in a specified period. The failure rate was analysed in terms of the total number of events, the total duration of events, as well as the average number and time per one day of longwall exploitation and one thousand Mg of excavated material. The conducted comparative analysis of the longwall failures indicates a noticeably higher failure rate in the case of longwalls equipped with plow complexes. The equipment characterised by the highest failure rate includes mining machines (plow, longwall shearer), powered supports, as well as beam stage loader and face conveyor.

Conclusions from the conducted analysis challenge the generally accepted opinion about the higher failure rate of shearer systems. The data comes from one mine, but the analysed time, as well as the number of systems covered by the analysis, demonstrate the advantage of shearer systems.

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